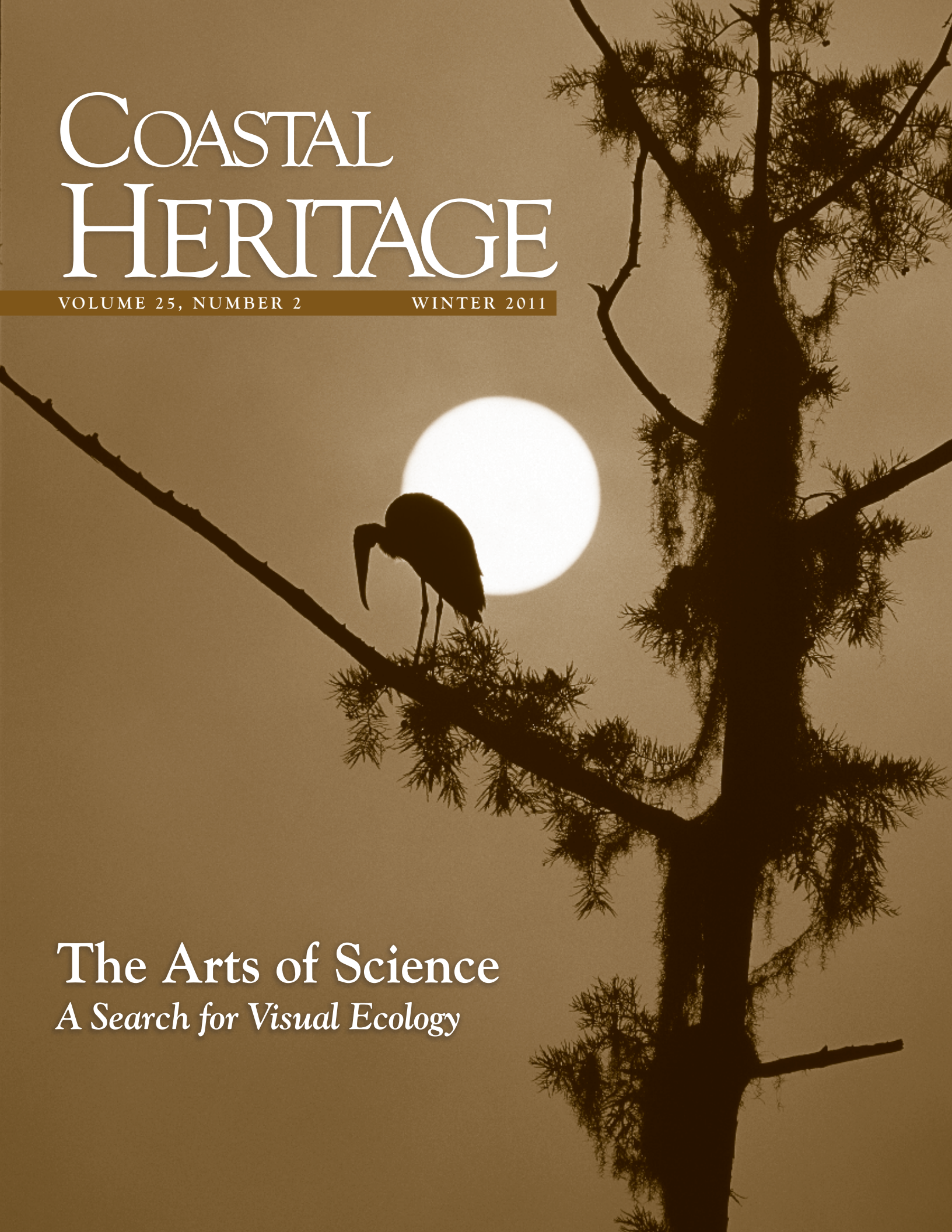

Coastal Heritage

VOLUME 25, NUMBER 2 WINTER 2011

The Arts of Science

A Search for Visual Ecology

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ON THE COVER:

A wood stork perches in a bald cypress in the South Carolina lowcountry's ACE Basin.
PHOTO/TOM BLAGDEN

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Coastal Heritage is a quarterly publication of the S.C. Sea Grant Consortium, a university-based network supporting research, education, and outreach to conserve coastal resources and enhance economic opportunity for the people of South Carolina. Comments regarding this or future issues of ***Coastal Heritage*** are welcomed at John.Tibbetts@scseagrant.org. Subscriptions are free upon request by contacting:

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BIRD'S EYE VIEW. *Mary Edna Fraser's aerial photographs from a '46 Ercoupe provide inspiration for her batiks of Carolina coastlines.*
PHOTO/CAROLYN RUSSO/SMITHSONIAN AIR AND SPACE MUSEUM

The Arts of Science

A Search for Visual Ecology

by John H. Tibbetts

Viewed from a great height, many barrier islands look like tattered ribbons suspended in the coastal ocean, as if one big wind could blow them to kingdom come.

"Only from an aerial perspective can you get a long view of time and land and the ocean," says Mary Edna Fraser in her art studio on a bluff above James Island Creek. "You get a different picture of a barrier island up there. You can see how narrow the land is, and how a barrier island is meant to come and go."

Fraser's medium is the batik—an ancient art of wax, silk, and dye—and her specialty is aerial portraits of shorelines, particularly those of the Carolinas.

She usually begins a batik by photographing a coastline from a '46 Ercoupe, a two-seater airplane that her father or brother pilots. During a single excursion, she shoots as many as 500 pictures that she later culls to about 20. She also consults maps and satellite images, and explores the landscape on foot.

Back in her studio, aerial photos near at hand, Fraser stands over a sheet of silk, penciling in contours of hillocks, maritime forests, beaches, salt marshes, and creeks. Then she drips hot, melted wax along her pencil marks. "Hot wax is a liquid medium," she says. "Batiks strike an emotional chord and express delicacy and a sense of place."

Later, she brushes dyes across the silk. Her use of color is often subtle and quiet, reminiscent of Japanese watercolors. But sometimes she deploys startling, almost lurid shades of red as if blood had been spilled across the fabric.

"Creating a batik is a very slow process," she says, "but it makes me calm, living in a world of color." After washing and ironing the fabric, she sews the batik at top and bottom for display rods.

Since 1993, Fraser has collaborated with Orrin Pilkey, a Duke University professor emeritus of geology. In their 2003 book, *A Celebration of the World's Barrier Islands*, photographs of Fraser's batiks are published side-by-side with Pilkey's scientific descriptions of coastal processes and critiques of coastal development. They have presented their work together at science museums and conferences, and they

are completing a book about climate change and oceans.

"When I see Pilkey dig in the sand and hear him talk," says Fraser, "I know that I could never absorb all of his knowledge about barrier islands. But I love being his perpetual student."

Fraser and Pilkey are in a vanguard of artists and environmental scientists who collaborate to reach beyond their disciplines and discover something new, to deepen the public's understanding of research findings, to draw attention to particular problems, or to explore fascinating borderlands between art and science. If the collaborators are lucky, they get inspiration in the process.

Fraser has found her art heightened by the experience. "Ever since I hooked up with Pilkey, my life has changed," she says. "I see that my work has a new purpose, that art and science together are more powerful than art or science alone."

ART AQUATIC. *A rendering of a "gill reef," a planned living-reef sculpture to be placed in New York harbor, one in a series of "geotherapy" art works by Brooklyn-based sculptor Mara Haseltine. The form of an oyster gill inspired this metal skeleton. A solar-powered mild electric current to the skeleton will induce accretion of calcium carbonate, a substrate for oyster attachment and growth. Eventually, the sculpture will transform itself into a productive oyster reef.*
GRAPHIC/MARA HASELTINE

ANCIENT TECHNIQUE. *In creating a batik, Mary Edna Fraser applies hot wax to silk with a tjanting tool.*
PHOTO/WADE SPEES

Britain is a world leader in supporting art-and-science projects, particularly on conservation themes. Over the past decade, British science agencies, art councils, science museums, and nonprofit organizations have sponsored art-and-science collaborations on issues such as endangered habitats, coastal erosion, climate change, and ocean pollution.

Still, relatively few U.S. institutions sponsor such efforts. American painters, sculptors, writers, photographers, and other artists usually must search for scientific collaborators on their own, and that's a challenge.

It turns out that a good scientist-guide is hard to find.

Cynthia Pannucci, founder/director of Art & Science Collaborations, Inc., a nonprofit organization in New York City, says, "In almost every research field, there are artists inspired by science. But scientists tend to keep to their own little realm; they are worried about losing their scientific credibility."

By necessity, American artists often become ardent suitors, while scientists, wary and standoffish, play hard to get. Over time, though, an artist's enthusiasm and stamina can win out, Pannucci says. "When a scientist sees how inspired an artist is about something they've been working on all their lives, they get excited themselves."

Mara Haseltine, a Brooklyn-based artist, studied innovative coral-reef restoration in Indonesia and incorporated this knowledge into her environmentally-based sculptures, which include a solar-power oyster reef in New York's harbor.

"I went to Indonesia on my own dime to learn," Haseltine says. "I put in countless volunteer hours [in building reefs]. I would show up, do the work, and learn the techniques. It was difficult; it was almost like hazing. But I would do anything to learn this stuff."

Mary Edna Fraser, meanwhile, set out to woo the reluctant Pilkey. "I had

to prove I could help him."

"Yes, Mary Edna did pursue me," he agrees. "I get a lot of calls from people, though she was persistent. I was skeptical initially that art and science could be related. But over the last two decades I have been trying to communicate with the public, and I realized that working with an artist could be extremely useful, a good way to illustrate science."

Pilkey aims to communicate what sea-level rise means for coastal communities and property owners as climate change accelerates. Property owners build homes and other structures at the ocean's edge in the belief that coastlines are permanent. When shorelines migrate inland, many landowners call for engineering solutions such as seawalls, bulkheads, levees, or extra sand pumped onto a beach from offshore.

Coastal engineering is a stopgap that only temporarily slows down shoreline migration inland. Engineering can also encourage further development in hazardous locations and contribute to losses of beach and salt marshes. Instead, says Pilkey, it's wiser to build farther back from the shoreline and relocate threatened structures or even allow some buildings to fall into the sea.

Fraser has learned her lessons well from Pilkey, whom she calls "boss" playfully or irritably depending on the tone of their most recent conversation. She says, "Just because you *can* engineer a shoreline doesn't mean you *should*."

Their collaboration is stormy. They debate which photographs or satellite images should be used as models for her batiks. "A lot of our relationship is arguing," she says. "We argue about what should be included in the book. He often wants to put in something that's so ugly that I can't do it. I'm not *trying* to be temperamental, I just am. My job is to keep the viewer watching. In the end, though, Pilkey and I are happy with what we've decided."

Pilkey acknowledges friction between them, but respects her professionalism. "It's quite an experience working with an artist. It's a different world. She has kept her artistic integrity."

Flowing water is a defining element of Fraser's coastal regions, where rivers and creeks wend through salt marshes, passing slender fingers of high ground. Her art emphasizes the ephemeral character of the coast, its constant shape shifting, and the lowness of the Carolina lowcountry. These themes resonate with Pilkey's research and advocacy.

Still, Pilkey and Fraser don't blur distinctions between his science and her art. Instead, they present their works side-by-side as separate but complementary means of observing.

His writing is precise, calm, and rather dry; he aims for scholarly detachment. Her batiks, meanwhile, are splashes of beautiful, moody colors. She hopes to provoke new ways of seeing familiar places and to stimulate emotional responses in viewers.

Artists and scientists often regard one another with mutual incomprehension. Artists observe the natural world aesthetically, drawing on emotions, intellect, and perhaps the mysteries of the subconscious. By contrast, scientists seek to study the natural world as objectively as possible in an effort to measure and analyze it. Pilkey and Fraser show how these different pathways of perception can be brought together to help us understand the natural world and our relationship to it.

Pilkey writes articles for newspapers and popular magazines, and he has published numerous books on coastal processes for non-scientific readers. But in his collaboration with an artist, he says he's reaching people whom he probably wouldn't have found by other means.

Their work together intrigues some of Pilkey's scientific colleagues, though he doubts that many will follow his example. The reality, he says, is that researchers tend to be ill equipped by temperament, training, and habit to work closely with anyone outside their intellectual spheres. Too often scientists build their careers among cognoscenti.

"Many scientists don't want to communicate with the public," says Pilkey. "They feel that's not where their skills are. They just want to do science. But we're recognizing the need for scientists to communicate more than ever. Science is the big news

FRAGILE ISLE. ***This 1997 batik by Mary Edna Fraser shows Bird Key, a brown pelican rookery, in the foreground. Bird Key later diminished in size mostly because dredging in the Stono River inlet for a Folly Beach renourishment project altered the main channel and drew sand from the rookery.***
SOURCE/MARY EDNA FRASER

SHIFTING SAND. *A 2009 batik of Edingsville Beach, S.C., which has experienced severe erosion over decades.*
SOURCE/MARY EDNA FRASER

today, and it's scientists who are asking the big questions."

A large fraction of the American public, however, apparently thinks that certain scientific questions shouldn't be asked or answered. A 2009 Gallup poll shows that only 39% of Americans say they believe in evolution by natural selection, although evolutionary theory is the backbone of all biological sciences.

A 2010 Gallup poll, moreover, shows that 48% of Americans believe that the seriousness of global warming is generally exaggerated. Their view, of course, contradicts declarations by every major scientific association in advanced countries around the world that climate change threatens water supplies, agriculture, and other crucial sectors.

Americans have contradictory attitudes about science. Up to a point, the public seems to admire scientific processes as effective tools to describe the world with clarity and accuracy. That is, through scientific analysis, researchers can begin to learn how the world really works and, at times, suggest policy solutions to problems.

Scientists examine an array of thorny questions in medicine and public health, the environment, space exploration, and military systems, among other fields. Their study results are usually acknowledged as honest efforts to find the truth, even when those results do not shape policy in the end.

But this broad public support for scientific thinking falls away when it comes to two of today's hot-button fields: evolution and climate change.

Almost every year, a number of state legislatures introduce bills that would allow or require science teachers to use classroom materials that dispute scientific understanding of evolution or climate change. These bills, so far, have failed to pass.

How can researchers in controversial fields make themselves heard and understood? How can they reach out to new audiences?

Few scientists are as innovative in this regard as Mark Pallen, a professor of microbial genomics at the University of Birmingham, in Britain, who initiated an art/science collaboration with Baba Brinkman, a self-described "rap troubadour."

Brinkman performs "The Rap Guide to Evolution," which evolutionary biologist and New York Times contributor Olivia Judson calls "one of the most astonishing, and brilliant, lectures on evolution I've ever seen."

A white man, Brinkman mocks the notion of racial categories in the context of human evolution:

I wasn't born in Ghana but Africa is my mama

Cause that's where my mama got her mitochondria . . .

A Canadian with a master's degree in English, Brinkman writes his rap lyrics and sends them to Pallen for critiques. Brinkman says he has "the only hip-hop show to have been peer-reviewed."

INSPIRATION. *Mary Edna Fraser's batiks of Atlantic coastlines hang in the foyer of the National Oceanic and Atmospheric Administration (NOAA) Hollings Marine Laboratory on James Island, S.C.*
PHOTO/WADE SPEES

THE MODERN CHASM BETWEEN ART AND SCIENCE

That Britain has become a world leader in art/science collaborations is fitting because the British were among the first to confront the chasm between science and arts-and-letters in the modern age.

It was a half-century ago that C.P. Snow gave his famous lecture at Cambridge University about the "two cultures." In 1959, Snow, a research scientist who became a successful novelist and man-of-letters, had friends in the two intellectual camps in Britain and America: the sciences on one side and the humanities on the other.

The humanities include a wide range of academic disciplines, including religious studies, law, the performing and visual arts, and others. But when Snow spoke of the humanities camp, he was referring primarily to that era's influential highbrows: serious novelists, poets, and literary critics, historians and philosophers, and prestigious publishers and editors.

Steeped in Homer, Plato, the New Testament, Augustine, and Shakespeare, members of this group viewed themselves as the Anglo-American world's only genuine intellectuals.

Scientists, though, scoffed. Science is the important thing now, they said. The humanities belong to the dusty past.

Snow said that each camp—the sciences and the humanities—had become deeply suspicious of the other, sometimes openly hostile, and as a result each had become intellectually "self-impoverished."

The opposing sides had lost a common language, Snow pointed out. His scientist friends had no interest whatever in the humanities, knowing "almost nothing at all" of novels, history, poetry, and plays. Artists and cultural figures were similarly ignorant of science. In the end, there "seems to be no place where the cultures meet."

Snow said that a "third culture" was needed to close the "communications gap" between the two antagonists. Scientists should learn more about the humanities, and artists should learn more about science. There should be a shared cultural space for the two camps.

IN HIS ELEMENT. *The nature photographer Tom Blagden searches for a place's "visual ecology." Here he's at work with his camera in the blackwater Rimini Swamp, part of the Santee Lakes system.*
PHOTO/HENK BRANDT

But as scientific knowledge has accelerated over the past half-century, researchers have become fascinated with new fields of demanding inquiry: string theory, the human genome, artificial intelligence, nanotechnology, and climate-change modeling. To acquire grants and academic promotions, scientists must delve deeper and deeper into sub-specialties, often at the expense of broader knowledge and experience. Scientists have become more technically sophisticated but seem more culturally isolated than ever, even from other researchers.

In his 1998 book *Consilience*, Edward O. Wilson, writes, "It's not surprising to find physicists who do not know what a gene is, and biologists who guess that string theory has something to do with violins."

Snow's ideal of a shared cultural space between science and art still seems a distant one. It's far more common for artists to reach out to scientists than the other way around; artists usually enter scientists' worlds to collaborate.

Some modern artists have already absorbed scientific ideas as central elements of their life-long education. Science is integrated in their intellectual and cultural upbringing, informing their understanding of the natural world. One such artist has worked for decades on a number of conservation efforts, including projects to preserve landscapes of the South Carolina lowcountry.

VISUAL ECOLOGY

Two decades ago, if you'd asked a longtime Charleston resident about the ACE Basin, you would've received a blank look. *What's that again?*

Centered about 45 miles south of Charleston is the vast region of the Ashepoo, Combahee, and Edisto river basins, known as the ACE Basin, one of the largest undeveloped watersheds on the U.S. Atlantic seaboard. The 350,000 acres of the ACE Basin is an important flyway for migratory birds and habitat for endangered species within its tupelo and cypress bottomlands, freshwater swamps and saltwater marshes, maritime forests, and longleaf pine forests. Rice plantations thrived there until the Civil War. In the early twentieth century, wealthy northerners bought up bankrupt plantations for hunting estates.

In 1987, a coalition of scientists, property owners, and environmentalists began looking for ways to conserve the region. Charles Lane, chairman of the ACE Basin Task

SENSE OF PLACE. *An early morning fog rises among tupelo and cypress at Cypress Gardens in Berkeley County. For most of human history, freshwater swamps were considered dangerous, disease-ridden places. But artists and scientists have helped the public understand their aesthetic and ecological values.*
PHOTO/TOM BLAGDEN

Force, says that he and his fellow conservationists were worried that resort and suburban development would eventually spread south from Charleston and north from Beaufort County.

Few South Carolinians knew about the region at the time; it seemed an empty, mysterious place on the map. Tourists drove through it on the way to someplace else. Even many locals didn't realize its ecological and historical values.

"Conservation depends on people identifying and caring about a particular place," says Tom Blagden, a nature photographer based in Charleston. "If a place doesn't have an identity, you need to create it."

Blagden is a fellow of the International League of Conservation Photographers, which brings together teams of photographers with scientists and conservationists to draw attention to critical habitats around the world.

In study after study, scientists have shown that the ACE Basin is ecologically valuable. But scientific evidence alone can't save an ecosystem from a developer's backhoe.

"Conservationists have traditionally justified protecting places on a scientific basis," says Blagden. "It's all been about data, which are essential for policy. You need data for fact sheets and scientific papers. But an emotional component is missing, and you need that emotion for public support. Fortunately, enough people recognized it was a problem for the ACE Basin and did something about it."

Many of Blagden's photographs of the ACE Basin show spectacular views of hidden woods and swamps, of wild places in flux, of life, death, and decay expressed in natural textures, forms, colors, and lines. His photographs show a fleeting visual harmony of nature.

Some of his most eloquent photographs are close-in shots,

emphasizing the ecological interdependence of living things on an intimate scale. In one image, we see delicate colors of lichen, a symbiosis of fungus and mold, growing amid a tiny fern on a living tree's bark. Five organisms at a single moment in time.

Blagden admires the work of the pioneering nature photographer Eliot Porter (1901-1990), who often composed close-in shots.

Understanding the natural world requires attention to the fine-grained particularities of a place, Porter argued. "The eye is numbed by vastness and magnificence, and passes over the fine details . . . Focus on the smaller, more familiar, more comprehensible objects, which, when finally seen in the context of the whole, are endowed with a wonder no less than the total. It is from them that the greatest rewards come."

Early on, Blagden was attracted to photography as part of his passion for landscape conservation. "I've never been that enamored of photography alone. It's always been about expressing the value of the natural world."

In his 1992 book of photographs and essays, *South Carolina's Wetland Wilderness: The ACE Basin*, Blagden pointed out that some visionary private landowners in that region were placing conservation easements on their properties. This was nothing less than revolutionary in the South. Landowners were giving up most development rights in exchange for reduced tax burdens, which could help keep lands in families for later generations. Property owners could still use their lands for traditional uses such as hunting, farming, and forestry. Easements would be perpetual and made to a qualified land trust or government agency that manages the easement.

During the past 20 years, the ACE Basin Task Force has approached property owners, one by one, explaining how conservation easements work. The task force has helped protect 206,000 acres in the ACE Basin, primarily privately owned.

"Tom's photographs showed what's important in the ACE Basin so that more people became interested in saving it," says Richard Porcher, a botanist and historian who has collaborated with Blagden. "Tom also explained to people what's being done to protect land. That's the big thing—he got the message out with examples of what landowners can do."

A board member of The Nature Conservancy in South Carolina, Porcher says that the ACE Basin's conservation success has encouraged landowners to protect additional hundreds of thousands of acres in the lowcountry of South Carolina and Georgia.

It takes Blagden many hours in the field to capture what he's looking for. How does he find the right

VANTAGE POINT. ***A great egret fishing in the Bear Island Wildlife Management Area of the South Carolina lowcountry's ACE Basin.***
PHOTO/TOM BLAGDEN

moment to shoot? Human beings, Blagden says, have evolved to respond emotionally and aesthetically to what he calls a place's "visual ecology."

Today, we are familiar with the language and ideas of ecology as a scientific discipline. Recall Barry Commoner's 1971 declaration of ecology: "Everything is connected to everything else."

Yet modern humans also perceive nature's interconnections from a far older place in our consciousness, an inheritance from our hunter-gatherer days, writes Denis Dutton, a New Zealand philosophy professor, in a 2009 book. We respond emotionally to a landscape's visual ecology, for instance desiring homes perched above waterways or verdant meadows interspersed with trees, much as our distant ancestors did.

Evolutionary biologists remind us that our long-ago ancestors were hunter-gatherers who moved from site to site, searching for safety and sustenance. Nomadic bands assigned their highest values to places with available food, water, and shelter, and a vantage point from which they could spot approaching competitors, predators, or dangerous weather. A meadow with fruit trees and flowering bushes perched on a bluff above a river was vastly preferable to a dry, rocky gully. Rich plant life and plentiful water attracted animals to be hunted.

A place with biological wealth and open vistas must have seemed beautiful to our distant ancestors, according to some evolutionary biologists. Small-scale biological richness within hand's reach must also have been pleasing. A nomad's sense of security and well-being became bound up with his aesthetics.

Perhaps that's one reason why Mary Edna Fraser's batiks, with their aerial views of richly textured, wide-open coastal landscapes reverberate so strongly, stimulating our ancient sense of visual ecology.

Even so, certain wild places—a freshwater swamp, a hardwood bottomland, or a soggy bog—can be more difficult for us to admire. To hunter-gatherers, these must have been dangerous places of lurking predators. Later, Europeans and then Americans drained swamps and other wet places to gain farmland, control pests, and prevent fevers. Swamps, in fact, were places to avoid or destroy.

Perhaps a wild, wet region like the ACE Basin needs a skilled interpreter to help us comprehend its visual ecology, an artist who can draw on both our aesthetic inheritances and our modern understanding of ecology as a scientific discipline.

"A natural landscape can seem chaotic, overwhelming to the average person," Blagden says. Nature can seem chaotic to Blagden, too, when he first steps into a wild landscape. But if he's patient, if he waits and observes long enough, he might have a chance to capture an animating natural order in an instant of changing light.

His goal, at its core, is similar to that of a scientist.

The biologist Edward O. Wilson writes, "In both the arts and sciences the brain seeks elegance, which is the parsimonious and evocative description of pattern to make sense out of a confusion of detail."

The artist and the scientist both search for sense, but the artist is more likely to arrive there by way of sensibility.

"It's important for us to understand the natural world less as individual objects or species, and more as phenomena in context, as a set of relationships, a tapestry," says Blagden. "You have to be open to the subtlest details, and the natural world will reveal itself if you give it a chance. Photography helps us make those connections among details. The challenge is to use the camera frame to define and reveal those relationships, giving us visual keys to reinforce science."

Reading and Web sites

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Baba Brinkman, rap artist. **www.babasword.com**

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Teaching science concepts through art

What turns children on to science?

"Some kids get excited about facts," says Kevin Kurtz, an educator and author of children's books on scientific themes. "But many other children respond on an emotional level; they need stories to get excited about science. I think it's fundamental human nature to respond to stories."

In his book, *A Day in the Salt Marsh*, for young readers (grades 1-3), with illustrations by Consie Powell, Kurtz takes children on an observational tour of coastal wetlands.

Kurtz explains in rhyme how salt-marsh grass, *Spartina alterniflora*, survives its harsh environment:

The cordgrass drinks saltwater
as the wind blows it about.
The leaves hold in the water,
but spit the salt back out.

His book describes the salt marsh's changes from morning to evening, and from high tide to low tide. It explains how various wetlands species respond to variations in light, temperature, and water level.

On each page, the book's illustrations provide both aerial and close-up images of coastal marshes and waterways, stimulating the students' observational skills. An illustration with an aerial view allows young readers to observe how tides rise and fall on a larger geographical scale. A close-in view helps them see how smaller creatures in the marsh, such as periwinkle snails, respond to those tides. The periwinkle snails climb the salt-marsh grass to stay above the rising water.

Kurtz was an instructor in a workshop for K-8 teachers at North Inlet-Winyah Bay in March 2010, sponsored by the Center for Ocean Sciences Education Excellence–SouthEast (COSEE–SE). The classes showed teachers how to integrate art and science into the classroom.

"Science should be taught in an interdisciplinary way," says Elizabeth Vernon Bell, marine educator for the S.C. Sea Grant Consortium and co-organizer of the teacher workshop, which was attended by elementary-school instructors, plus middle-school art teachers and science teachers.

CONNECTIONS. ***Marie Nichols, an art teacher at the Charleston County School of the Arts, and her students assemble this 8-by-20-foot mural of Noisette Creek. The mural was commissioned by the Michaux Conservancy and the Ashley-Cooper Stormwater Education Consortium to help students combine their artistic skills with knowledge of local ecology. The mural is mounted outside at the former Charleston Navy Yard, Building Number 25.***
PHOTO/WADE SPEES

"This workshop was intended to engage some teachers who are interested in science but lack confidence in how to approach it," says Bell. "The classes showed them how to teach science concepts through art. It also helped science teachers who were nervous about venturing into art."

The program provided participants with instruction on writing prose/poetry, visual arts, and nature photography, as well as the fundamentals of estuarine ecology.

Based on the science concepts presented in the field, each small group of teachers developed a story based on the teachers' own drawings, photographs, and prose. The teachers modeled what their students would do back in the classroom—create 3-5 page stories that include science facts and artistic channels to convey those facts. The workshop also challenged teachers to use technology. The stories were created in PowerPoint for use on SmartBoards in the classroom.

The workshop could foster future collaborations among science teachers and art teachers, helping them to see similarities between the two fields.

"At face value, art and science are polar opposites," says Bell. "But both art and science begin with observation. It's through observation that scientists begin to ask questions and investigate them with experiments. It's also through observation that artists capture their ideas and experiment in various forms."

Can we rebuild the family of art and science?

Until 150 years ago, art and science belonged to a close-knit family of intellectual pursuits. The term "art and science" was shorthand for the sort of activities to be encouraged in intelligent, well-born young men. (Women were allowed to participate in the arts but rarely in the sciences.)

Men who studied science were called "natural philosophers" and those who studied botany, horticulture, agronomy, and related sciences were called "naturalists" or "natural historians."

In the seventeenth century, the most influential natural philosophers—Francis Bacon and Isaac Newton—were admired first as literary figures, even beyond their scientific accomplishments. Any new idea accepted into university life was inevitably folded into the dominant academic fields of theology and the classics. Science, then, was a subset of humanistic thinking.

USEFUL ART. *A great horned owl* (Bubo virginianus) *in a color engraving by R. Havell after a drawing by John J. Audubon, who blended scientific observation and artistic skill.*
SOURCE/LIBRARY OF CONGRESS

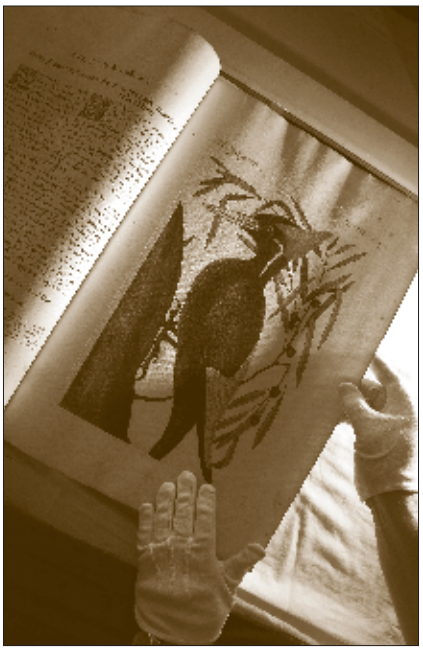
Still, science was also admired for its economic and political uses. In London, the Royal Society, the first important scientific organization in Europe, was created in 1660 to organize fundraising for scientific tools and fieldwork. Over the next two centuries, advances in science and technology (called the "useful arts") became increasingly important to the British economy, stimulating developments in manufacturing, navigation, medicine, and other fields.

Men were admired who could speak and write elegantly about the ideas and tools of science, as well as understand the worlds of art and business. They gathered at the Royal Society or in coffeehouses, talking of poetry, science, and commerce. Their intellectual ideal was the polymath, a font of knowledge in many fields.

In 1699, the pharmacist and writer John Houghton wrote that "coffeehouses improve arts, merchandize, and all other knowledge; for here an inquisitive man, that aims at good learning, may get more in an evening than he shall by books in a month."

In the eighteenth century, a passion for natural philosophy spread from London to British provincial cities and the American colonies. In 1748, a group of young men created the Charleston Library Society, the first scientific society in the southern colonies of British North America. There were 10 "Literary and Philosophical" societies in provincial British towns and cities by 1780. Fifty years later, there were nearly 70 of these societies, borne on a wave of Victorian-era enthusiasm for the useful arts, especially natural history.

Perhaps the spirit of the age is reflected in Samuel Johnson's advice in a 1784 letter to a young woman friend who was to visit the astronomer William Herschel and his famous telescope. "He can show you in the night sky what no man before has ever seen, by some wonderful improvements he has made in the telescope. What he has to show is indeed a long way off, and perhaps concerns us little, but all truth is valuable and all knowledge pleasing in its first effects, and may subsequently be useful."



POLYMATH. *Mark Catesby, an English writer, artist, and explorer, completed a popular two-volume "natural history" about North American fauna and flora in the early eighteenth century. The ivory-billed woodpecker* (Campephilus principalis)*, shown here, is thought to have become extinct in the twentieth century.*
PHOTO/WADE SPEES

By then, among upper levels of British society, an embrace of scientific knowledge was expected, even required. There was a "component of polite society, in which one signaled one's civility and politeness by displaying or faking an interest in science," writes Joel Mokyr, an historian at Northwestern University, in a 2009 book. Americans of a certain wealth and status also showed interest in science as an indicator of their cultural sophistication.

In the eighteenth century, a very

popular literary form called "natural history" emerged. A natural historian would blend travel stories, autobiography, and a catalogue of scientific observations, describing and illustrating the characteristics of flora and fauna.

Most naturalists were generalists, fascinated by wild creatures with shells, fins, fur, or feathers; with two, four, six, eight, or no legs; and also plants, minerals, and fossils.

Writers in all genres drew from natural histories' gold mines of anecdote and observation. Poets wrote odes and preachers penned sermons about natural curiosities in faraway places. Novelists interrupted their storylines with side trips into natural history —think of Herman Melville's dissertations on whales in *Moby-Dick*.

The first masterpiece of natural history by an American was published in 1791. In his *Travels through North and South Carolina, Georgia, East and West Florida*, William Bartram explores the colonial wilderness of the American southern colonies, confronting alligators, rattlesnakes, and other beasts. His illustrations and descriptions show how various species fit into their habitats. In his understanding of these species-habitat interconnections, he foreshadowed modern principles of ecology.

Illustrators would kill specimens to draw them later at close range. European collectors of illustrations sought taxonomic accuracy, but some also prized a subtle artistic license. They admired drawings or etchings with warmth and vitality—illustrations that by creative alchemy seemed to bring creatures back to life—and Bartram's illustrations do have that mysterious quality.

By all accounts, Bartram never called himself an artist; his aim was to serve science. Still, his only book, *Travels*, has found its place in the American canon. Admired by generations of readers, *Travels*, with its vivid, compelling prose and illustrations, is a lasting work of literature.

Bartram's book influenced later naturalist-authors such as Charles Darwin in *The Voyage of the Beagle* and Henry David Thoreau in *Walden*; and ornithologist-illustrators Alexander Wilson in *American Ornithology* and John James Audubon in *Birds of America*.

Charles Darwin spanned two eras of naturalists' investigation. As a young man, Darwin was an explorer and an author of a popular natural history about his voyage on the *H.M.S Beagle* to the New World. Then, in 1859, Darwin helped usher in a new age with *On the Origin of Species*. His theory of evolution by natural selection offered a bold theoretical framework for biology, botany, zoology, geology, archaeology, and other disciplines, opening up explosions of new research questions. Scientists increasingly specialized to keep up with new knowledge.

After *Origin*, the naturalist-explorer-author-illustrator who makes important discoveries faded in importance, and the professional scientist-specialist increasingly made advances with new findings.

In the early twentieth century, some institutions of higher learning in the United States focused increasingly on research, following the example of the University of Berlin, which had established graduate training as a central element of the institution. Johns Hopkins University and University of Chicago imitated the German principles of graduate training.

EARLY NATURALIST. ***In 1791, William Bartram published the first American masterpiece of natural history. British Romantic poets William Wordsworth and Samuel Taylor Coleridge read his book with fascination, and Coleridge borrowed phrases from Bartram.***
SOURCE/LIBRARY OF CONGRESS

Eventually, academic departments became separate fiefdoms, each with its own methodology and credentialing process. A professor in one field did not encroach on another field. Academic departments became like silos, rigidly contained and separate.

As U.S. research universities expanded dramatically in the mid-twentieth century, many scientific specialists were hired, promoted, and awarded tenure. Naturalists, with their multi-disciplinary knowledge of the natural world, were often seen as creakily old-fashioned.

But, in a 1998 book, Edward O. Wilson, the Harvard biologist, writes that narrow scientific specialization is actually what's old-fashioned today, an artifact of academic life that has outlived its usefulness. Too often, the modern researcher sees the world only through the lens of narrow specialization and can't comprehend larger truths.

The era of the specialist is coming to a close, argues Wilson. Specialists will reach a ceiling to their ambitions. Instead, many leaders of tomorrow's science and society will be generalists who can draw on knowledge from many different fields. The polymaths who know the wisdom of the humanities and the sciences would become our culture's intellectual heroes.

Would it be too much to ask that the next generation of scientific Ph.D.s should be Doctors of Philosophy in the original sense, as men and women fluent in ethics, literature, and the arts? Could the sciences and the humanities once again belong to the same extended family?

"We are drowning in information, while starving for wisdom," Wilson writes. "The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."

NEWS & NOTES

Consortium receives high marks from National Review Team

On September 21-22, 2010 the S.C. Sea Grant Consortium was evaluated by an external National Sea Grant Site Visit Review Team, which was charged with reviewing and making recommendations for improvement on the Consortium's program management and organization, stakeholder engagement, and collaborative network activities. The Team commended the Consortium for its effective management and organization; creativity; stakeholder engagement; collaborative networking; local, state, regional, and national leadership; ability to leverage resources and funding; and interactions with the private sector. Of particular note is the fact that the national Site Visit Team made no recommendations for program improvement.

Among the Team's many positive conclusions were the following:

- "There are currently eight institutions in the Consortium… The Program's inherent multi-institutional structure has created many opportunities and, given the effective leadership of the Program, significant efficiency and productivity."
- "Site Visit participants noted that the structure and performance of the Consortium helped convince individual institutions that creating and facilitating partnerships would lead to more effective use of funds."
- The Consortium, "through the use of its Program Advisory Board, gets excellent guidance on initiatives related to coastal and marine resource issues and opportunities."
- The Consortium "blends science, outreach, and communication components well."
- The Consortium "can look at a state issue as a national issue, translate it to a regional level and then bring the issue back to a national level, not as a problem, but as a solution. Thus the Consortium is comfortable in describing and solving issues in a simultaneous local (state), regional, and national context."
- The Consortium's "stakeholder engagement is broad, impressive, diverse, and multidimensional. The Consortium has been entrepreneurial and has used creative 'out-of-the-box' thinking. This has leveraged credibility and provided opportunities to match resources to needs."
- The Team "was also impressed with the Consortium's work with the private sector where, through education and creative partnering, private sector resources were brought to bear in areas with aligned public and private goals."
- *Coastal Heritage* magazine "is an excellent publication, and the Consortium should attempt to increase readership, in print and online."

To view the entire National Sea Grant Site Visit Review Team report, please visit www.scseagrant.org/Content/?cid=461.

Greenberg re-elected as Consortium board chair

Dr. Raymond S. Greenberg, president of the Medical University of South Carolina (MUSC), has been re-elected as chair of S.C. Sea Grant Consortium's Board of Directors.

Dr. Raymond S. Greenberg
PHOTO/MUSC

Greenberg became president of MUSC in January of 2000. Prior to coming to Charleston, he served on the medical school faculty at Emory University and was the founding dean of the Rollins School of Public Health there. An immediate challenge was to restore fiscal health to the university's hospital. This was achieved through organizational restructuring and operational improvements, which then allowed the university to undertake a progressive replacement of its aging hospital facilities. He arrived at the Medical University in 1995 as the vice president for academic affairs and provost.

He holds a medical degree from Duke University, a master's degree from Harvard, and bachelor's and doctoral degrees from the University of North Carolina. Nationally recognized for his research on cancer, Dr. Greenberg has served on many scientific advisory boards and holds two honorary doctorates.

"We are extremely pleased that Dr. Greenberg will serve as Board chairman for the next year," said M. Richard DeVoe, executive director of the Consortium. "His leadership and guidance will be instrumental as the Consortium pursues opportunities for relevant coastal and ocean research and outreach efforts that address the ever-growing needs of the state and its people, especially in light of the difficult budget challenges that we face moving forward."

NEWS & NOTES

Unique interactions cause Long Bay "dead zones"

After twice in six years finding sizable "dead zones" in Long Bay, scientists now believe that an unusual interaction of forces caused these low-oxygen—or hypoxic—events. Waters that reach hypoxic levels are no longer able to sustain most animal life.

Long Bay (the coastal ocean from Cape Fear, N.C. to Winyah Bay, S.C.) experienced the first observed hypoxic event in the summer of 2004, and two additional events were observed in the summer of 2009.

Low-oxygen levels in 2004 caused a flounder jubilee in the Myrtle Beach area. The flatfish were plentiful and slow moving because of a zone of low-oxygen water that drove suffocating flounder toward the shoreline. In response to the 2004 event, a Long Bay Working Group (LBWG) of state and federal agency and academic partners was formed to study the phenomena and identify causes of low-oxygen problems.

"We believe that Long Bay's hypoxic events are caused by an interaction of physical and biological processes that's unique to the region," said Denise Sanger, LBWG facilitator and assistant director for research and planning with the S.C. Sea Grant Consortium.

Physical oceanographic processes in Long Bay are naturally occurring but play a crucial role. In the summers of 2004 and 2009, strong southwesterly winds pushed cold, deep water from far offshore toward the Long Bay beachfront in a process called upwelling. These southwesterly winds and resulting upwelling were persistent, constraining a mass of colder water in the nearshore zone just seaward of the surf zone.

In the Myrtle Beach area, a tidal creek, locally called a "swash," carries nutrients and organic matter into the coastal ocean.
PHOTO/CLAY MCCOY/S.C. SEA GRANT EXTENSION PROGRAM

At the same time, hot summer weather days added to temperature stratification in the water column. That is, warm surface waters could not mix with cold waters at the bottom.

On the landward side, nutrients and organic matter draining off highly developed uplands is thought to be another important contributor to low-oxygen events. Tidal creeks (locally known as swashes), stormwater-discharge pipes, and groundwater all carry nutrients and organic matter into the coastal ocean.

Under typical conditions, this material is widely dispersed. But when constrained within Long Bay's nearshore zone, the material stimulates bacterial activity. The bacterial communities consume oxygen at a faster rate than it can be replenished, resulting in hypoxia.

After the 2004 event, the LBWG established research and monitoring efforts. The LBWG continues to collect data critical to increasing our understanding of conditions in Long Bay. The scientific studies are funded and conducted by the S.C. Sea Grant Consortium, S.C. Department of Natural Resources, S.C. Department of Health and Environmental Control–Office of Ocean and Coastal Resource Management, University of South Carolina, and Coastal Carolina University, among others.

The Coastal Conservation Association, a recreational fishing group, and the Apache Pier Campground have also helped fund continuous monitoring sensors for oxygen levels at Apache Pier, which are critical to identifying and tracking hypoxic events. As a result, the researchers in 2009 could identify a relatively narrow zone affected by hypoxia, beginning just beyond the surf zone to about one mile offshore from N. Myrtle Beach to Surfside Beach.

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EBBS & FLOWS

Coastal GeoTools 2011

Myrtle Beach, South Carolina
March 21-24, 2011

Mark your calendars for the conference that focuses on the technical information needs of the nation's coastal programs. Coastal GeoTools 2011 addresses building the Digital Coast, a Web platform that provides access to geospatial data, tools, and technical training. Special interest meetings cover a variety of topics in-depth. For more information, visit geotools.csc.noaa.gov.

2011 National Hurricane Conference

Atlanta, Georgia
April 18-22, 2011

The primary goal of the National Hurricane Conference is to improve hurricane preparedness, response, recovery, and mitigation to save lives and property. The conference serves as a national forum for federal, state, and local officials to exchange ideas and recommend new policies to improve emergency management. For more information, visit www.hurricanemeeting.com.

Coastal Zone 2011

Chicago, Illinois
July 17-21, 2011

Our coastal communities and estuarine, marine, and Great Lakes environments are changing. Impacts of development, invasive species, and global climate change require new approaches to managing ocean and coastal resources. Join us at Coastal Zone 2011 to explore these challenges and learn from the experiences of leaders from across the nation. For more information, visit www.doi.gov/initiatives/CZ11.

Subscriptions are free upon request by contacting: Annette.Dunmeyer@scseagrant.org

ATTENTION SCHOOL TEACHERS! The S.C. Sea Grant Consortium has designed supplemental classroom resources for this and past issues of *Coastal Heritage* magazine. *Coastal Heritage Curriculum Connection*, written for K-12 educators and their students, is aligned with the South Carolina state standards for the appropriate grade levels. Includes standards-based inquiry questions to lead students through explorations of the topic discussed. *Curriculum Connection* is available on-line at www.scseagrant.org/education.